Zero Retries issue 0046 2022-05-13

Technological innovation in Amateur Radio - Data Communications; Space; Microwave… the fun stuff! The Universal Purpose of Ham Radio is to have fun messing around with radios - Bob Witte K0NR. Ultimately, amateur radio must prove that it is useful for society - Dr. Karl Meinzer DJ4ZC. We are confronted by insurmountable opportunities! - Pogo. Nothing great has ever been accomplished without irrational exuberance - Tom Evslin. Irrational exuberance is pretty much the business model of Zero Retries Newsletter - Steve Stroh N8GNJ. What's life without whimsy? - Dr. Sheldon Cooper.

Zero Retries is a unique, quirky little highly independent, opinionated, self-published email newsletter about technological innovation in Amateur Radio, for a self-selecting niche audience, that's free (as in beer) to subscribe.

About Zero Retries

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Request To Send

Countdown to Hamvention 2022 - May 20-22, in Xenia, Ohio:
~~24~~ ~~23~~ ~~22~~ ~~21~~ ~~20~~ ~~19~~ ~~18~~ ~~17~~ ~~16~~ ~~15~~ ~~14~~ ~~13~~ ~~12~~ ~~11~~ ~~10~~ ~~09~~ ~~08~~ ~~07~~ ~~06~~ ~~05~~ ~~04~~ ~~03~~ ~~02~~ ***01*** week…

Greetings from various comfortable hotel rooms along Interstate 90 in various Midwest states.

Starting next Thursday evening, I'll be in total Amateur Radio immersion mode at Hamvention through Sunday evening. If it isn't clear by now in reading Zero Retries, my focus at Hamvention will be on looking for products (and perhaps services?) and Forum presentations that showcase technological innovation in Amateur Radio, especially in data communications, space operations (including Earth Moon Earth - EME / Moonbounce) and microwave. I hope to *see* some new and interesting products from the vendors. I hope to *hear* some new and interesting information in the Forums.

Funny story that kind of puts technological innovation into perspective. My old phone had given great service for nearly five years, but it was finally time for a new unit. After weighing all the pros and cons of a new phone, I dug pretty deep to, for the very first time, buy a top of the line iPhone - an iPhone 13 Pro Max with 1 TB of storage. Yes, that's *one Terabyte of storage… in my pocket*. I was planning to bring a video camera to Hamvention, but after purchasing this phone with its 1 TB of storage, that's no longer necessary. Technology evolution is amazing, if a bit expensive at times.

de Steve N8GNJ

Monitor and Record Everything on the 2m Band

The things I learn on Twitter…

Followed by:

I wish I could do justice to all of this. I can *barely* follow this stuff… and don't have the mental chops to fully understand it, but I do get that *this is now possible*, and I find that fascinating!

This is technological innovation in Amateur Radio - recording everything on the 144-148 MHz 2 meter band… all of it. Anything interesting, play it back. Note that you're not monitoring FM transmissions on 144-148 MHz (like a really good fast scanner)… *you're digitizing **all** the signals in the **entire** band*. Want to hear the SSB stations in the weak signal simplex portions of 2 meters? Play those back through a SSB decoder. Etc. That's just as easily doable for the 50-54 MHz band, 222-225 MHz band, and 420-450 MHz band… or any other segment of spectrum that your software defined receiver can handle.

Someone clever enough with software can be putting that stream into a buffer (RAM is still cheap'ish these days, especially with 64-bit operating systems), find any energy peaks, spit out those as post-processed, and listen to just the interesting stuff with all of it saved for later post processing if you wish. It's hard to wrap my head around this - not *scanning through 144-148 MHz… **recording** it all*.

And, yes, I know I'm being overly enthusiastic about this. It did sound a bit too good to be true, and Phil Karn KA9Q offered a reality check:

Note that what Clayton Smith wants to do… *record the entire 144-148 MHz band… is doable*… it's just not doable with Smith's *current hardware* (Airspy

HF).

This is the kind of experimentation that justifies Amateur Radio in the 21st century - something entirely new that wasn't possible with older technology (hardware radios).

Imagine what you could do with a $399 Kraken SDR unit instead of a $169 Airspy HF+ Discovery unit. Basically Kraken SDR is five integrated software-defined receivers tunable from 24 MHz to 1766 MHz with a common USB-C connection and common timebase. It seems to me that if monitoring the 4 MHz of 50-54 MHz or 144-148 MHz is a bit challenging for an individual software defined receiver, I'll guess the Kraken SDR would be up to such a challenge.

ShaRPiKeebo - A tiny Linux computer…

… with a keyboard, a daylight-readable screen, and a long-range transceiver.

I was completely unaware of this; I only found it as I was checking Crowd Supply for the previous article.

Honestly, some weeks it feels like I'm writing about science fiction. In Zero Retries 0044 I said:

> We need portable wireless data communications APPLIANCES! (For Amateur Radio).

I cited the venerable Motorola KDT-840 that was self-contained with battery, display, keyboard, and (data) transceiver all in a "handheld" unit.

A mere couple of weeks later and I stumble onto *yet another* interesting project on Crowd Supply - ShaRPiKeebo:

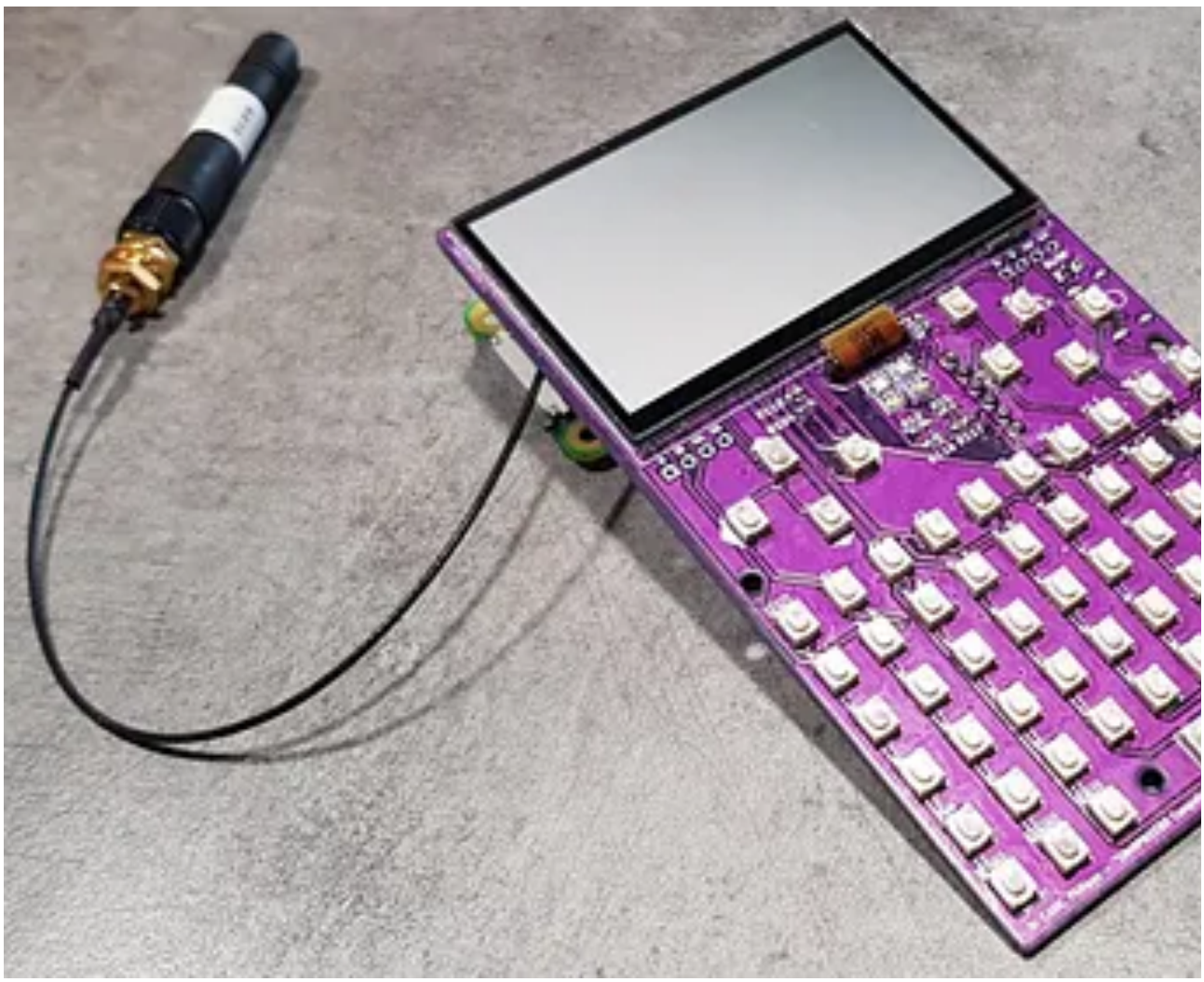

Image courtesy of Morpheans / Crowd Supply

> ShaRPiKeebo is probably the smallest Linux computer you'll find with a physical QWERTY keyboard. Measuring just 6 x 11 x 1.5 cm and powered by a Raspberry Pi (RPi) Zero 2 W, it features a 400x240-pixel, low-power, daylight-readable, black-and-white SHARP Memory Display and an RFM95 long-range wireless transceiver.

So… here we go. This is an open source project. With this as a template, a different form factor LCD, a different form factor "keyboard", and 3D printing files for the case and keyboard, and we're pretty close to the "messenger" unit I imagined. The RFM95 mentioned for the radio connectivity is a flexible

transceiver module that seems most commonly used for LoRa. And of course, the Raspberry Pi Zero 2 W incorporates 2.4 GHz Wi-Fi and many Bluetooth modes.

Add a power system and an enclosure, and we have a “data portable” device.

If someone launches a product based on this design and adds a radio that will work on 144-148 MHz, 222-225 MHz, or 440-450 MHz (US Amateur Radio bands) and especially will work through Amateur Radio repeaters, I expect they will sell a *lot* of them.

ZR > BEACON

From Amateur Radio Digital Communications (ARDC), written by ARDC Communications Manager Dan Romanchik KB6NU (the alter ego of Zero Retries Pseudostaffer, author, and blogger Dan Romanchik KB6NU):

> **What makes a good proposal?**
> As ARDC grows, we’re getting more proposals than ever before, and the way we evaluate grant proposals is evolving. Of course, we’re still looking for proposals that support and promote amateur radio, advance education, and advance the state of the art in amateur radio and digital communications. What’s different is how we evaluate the proposals: we now have quarterly review cycles and a ranking system that uses consistent criteria. Given this new framework and increase in competitiveness, here’s how to improve your chance of success.

If you’re considering submitting a grant proposal to ARDC, I recommend this article. Dan offers some significant insights into ARDC’s updated evaluation process for the significantly increased number of grants that ARDC is receiving in 2022. I’m really glad Dan wrote this excellent article because, as a member of the 2020 and 2021 ARDC Grants Advisory Committee, I’m constrained from doing so. What I can tell you is that ARDC is receiving a *lot*… of *very interesting* grant proposals in 2022.

Updata

The Halo TD-XPAH (The first open source 802.11ah [902-928 MHz] scalable long range Wi-Fi development platform for engineers and experimenters) is now **305%** funded. They will be manufactured! I wrote about this radio in Zero Retries 0038.

Feedback Loop

- **Bill Buhler AF7SJ re: Zero Retries 0043:**
  Hi Steve - In your statement about the need for a VHF / UHF about Flex Radio I felt like you lost your way on the data rate being limited to 56k on 70cm. You see, our symbol rate is limited, but, not our data rate. Our max bandwidth is 100khz if we use a symbol that can represent 16 states inside that bandwidth then we could send at 224 kbps (4 bits per symbol). This seems imminently doable, it just requires a quiet channel and a wide SNR, since we can trade SNR for the data rate. I'd note that LTE is now using 256 QAM, so a entire byte is transferred per symbol. IF we as amateur radio operators would adopt that it would give us a raw data rate of 448kbps. Yes the FCC regulations are a pain, but they also offer a opportunity to look at efficiency and innovation.

  I'm looking around and feel like we are on the cusp of a amateur radio renaissance, with experimenters and ideas floating all around us. But the ideas are dammed up by those who either lack imagination, or who gate keep saying "that's not ham radio", or even "the rules don't allow that". When it's possible now to engineer around the rules with software very effectively.

  Bill - As I understood it (quite possibly incorrectly), yes we CAN use 100 kHz on 420-450 MHz but yes, the symbol rate is limited to 56k in 440, but there's no symbol rate limit in the higher bands. Unfortunately, the US 420-450 MHz band is the "sweet spot" for Amateur Radio - reasonable 30 MHz (20 MHz North of Line A) spectrum, channel sizes up to 100 kHz, and good propagation characteristics.

  For those who enjoy an intellectual RF engineering challenge, yes, engineering around the 56k symbol rate limitation (to implement data rates faster than 56 kbps) might be an interesting, fun intellectual exercise, but such folks seem to be missing in action in Amateur Radio. What illustrates this perspective best is is New Packet Radio - for it to be “legal” (to the armchair lawyers) in the US, it still uses the same 100 kHz channel, but merely retards the data rate versus its native operation of 500 kbps for other parts of the world.

  I *really* think the better thing to do instead of engineering around the symbol rate silliness is to just get rid of it in this era of Software Defined Radio technology. *Then* Amateur Radio might be a bit more interesting to those who can implement those high speed modes (and attract more interest from Amateur Radio Operators in other parts of the world that don't have symbol rate silliness).

  Hi Steve - I agree that 70cm is at a sweet spot with hobby RF. The antenna's aren't too small to design and build reliably. Feedline losses are not as dramatic as they are when using the SHF and microwave frequencies.

  RF data speeds and ranges are always tradeoffs. When I was first licensed I dreamed of being able to put raw data on the air without sidebands and a wonderful mentor of mine K7HFV (SK), explained that I needed to learn about Mr. Shannon's research on channel capacity. It was very eye opening to do so.

  The antiquated FCC rules were based on RTTY using FSK. They wanted to limit the bandwidth and specified both a max data rate and a bandwidth. That was unfortunate, but if you look at it the bandwidths match up with the best efficiency a FSK transmitter could be expected to achieve at the time. But this isn't the 60's anymore. With DSPs we can now can easily do MFSK as well as other more complicated modulation schemes. After a lot of math on the subject I concluded that coherent FSK had the best weak signal propagation, if we have just a little more power and a quiet channel, we can put a heck of a lot more data over the air than FSK lets us inside the rules, and take up less bandwidth doing it.

  Since there are many users of our bands I believe trying to squeeze as much data into the airspace as possible while minimizing the bandwidth is a very good thing.

  ARDOP and VARA both use a very slow symbol rate (42 symbols per second), but by employing many carriers and in the case of QAM multiple amplitude levels are able to transfer much more data. If someone were to take the multiple carriers + QAM VARA approach to a 100kHz channel we

could have a signal 464 carriers and a net data rate over 100840 bps, the raw data rate would be even higher.

So it's really easy to get hung up on the FCC wording, but, it doesn't say how many data carriers we can use, just how fast we can change states (the symbol rate). If our symbols convey more information we get more information.

Now, what I would love to see someone develop is a broadband SSB transceiver that is DSP driven. Something that would let us put out a 100kHz wide, or wider signal (depending on the band), so that enterprising amateur radio operators can write software like VARA FM that really efficiently send out the data.

Bill - The RPX-100 Project that I've mentioned in Zero Retries a few times now is a Software Defined Transceiver (LimeSDR Mini) at its core, with driver / power amplifiers for 50-54 MHz (6 meters), 144-148 MHz (2 meters), and 420-450 MHz (70 centimeters). Your description of "… broadband SSB transceiver that is DSP driven. Something that would let us put out a 100kHz wide…" is exactly why I think the RPX-100 (and similar radios to follow that are, at the core, a fully Software Defined Transceiver) will help us get to much more interesting and faster data modes on Amateur Radio.|

Thus, I think we're "nearly there" for reasonable hardware to begin experimenting with higher data rates on the US Amateur Radio 420-450 MHz band. What we seem to lack is the *interest from talented folks to do so*. No other radio service / system / country with Amateur Radio experimenters has to work around such antiquated symbol rate regulations regarding data rates. Thus it's my guess that the symbol rate issue is a primary impediment for "talented folks" to begin experimenting with higher data rates on the US Amateur Radio 420-450 MHz band. One looking at the task could reasonably think "why should I have to put so much effort into minimizing the number of symbols? and I think they're correct to think so.

- **John Kreno N3XKD - comment in Zero Retries 0045:**
Steve - Do you know if there is any effort to remove some of the arcane data speed restrictions on the VHF and UHF bands ? This is not a circle that I travel in. Thanks for any light you may be able to shed.

  John - I am not aware of any current such effort. The last action I'm aware of is an ARRL article from 2019 - ARRL Renews Request for FCC to Replace Symbol Rate with Bandwidth Limit, and *that's* regarding symbol rate limits on HF... nothing about the even more arcane symbol rate limits on US 50 MHz through 450 MHz bands. I recall reading plaints in minutes of ARRL Board and other meetings, but only that - plaints, with no substance, no follow-through, no formal contact with the FCC, etc.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- Pseudostaffer Dan Romanchik KB6NU for continuing to spot, and write about "Zero Retries Interesting" items on his blog that I don't spot on my own.
- Southgate Amateur Radio News consistently surfaces "Zero Retries Interesting" stories.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

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More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted in ~~beautiful Bellingham, Washington, USA~~ on the road.
2022-05-13

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